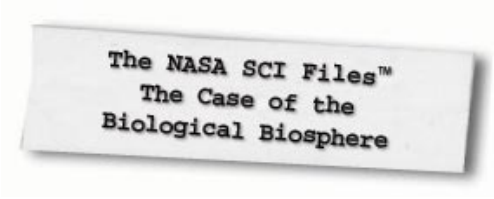


Segment 2

Jacob continues to insist that quarantine and a Health Stabilization Program will keep him well before his vacation. The other tree house detectives are not convinced and decide to continue the investigation. They visit Dr. D to learn more about cells, tissues, organs, and organ systems. Dr. D sends the detectives to Mr. Frank at Tidewater Community College in Virginia Beach, Virginia, who helps the detectives learn about three types of bacteria. He tells them that some bacteria is actually "good" bacteria. Back at the tree house, the detectives decide that they need to learn more about how an epidemic spreads. They contact the Society of Women Engineers (SWE) to help locate a NASA SCI Files™ Kids Club. Sigsbee Elementary School in Key West, Florida is conducting an experiment that is perfect for demonstrating the spread of infectious disease.

Objectives

The students will

- investigate an animal cell
- model the following: cell > tissue >organ > system > body
- understand three types of bacteria
- learn how an epidemic occurs

Vocabulary

bacillus—an aerobic, rod-shaped, spore-producing bacterium

cell—the smallest unit or building block of all living things

coccus—a spherical or nearly spherical microorganism, especially a bacterium

cytoplasm—a jelly-like material in cells that is the living part of the cell

digestive system—the group of body parts used in digestion

epidemic—an outbreak of a disease that spreads more quickly and more extensively among a group of people than would normally be expected

homeostasis—a state of equilibrium, or a tendency to reach equilibrium

immune system—the interacting combination of all the body's ways of recognizing cells, tissues, objects, and organisms that are not part of itself, and which initiates the immune response to fight them

nucleus—the control center that directs all cell activities

organ—a group of different tissues such as the heart, lungs, or stomach working together to perform a job

respiration—the process by which oxygen combines with glucose to produce energy and two waste byproducts, carbon dioxide, and water vapor

respiratory system—the group of body parts used in respiration

streptococcus—a spherical bacterium that often causes disease, for example, scarlet fever or pneumonia. The bacteria link together in pairs or chains.

tissues—a group of similar cells that perform a special job

toxin—a poison produced by a living organism, especially bacteria, capable of causing disease and also of stimulating the production within the body of antibodies to counter their effects

variable—something capable of changing or varying

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich the existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 2 of *The Case of the Biological Biosphere*, discuss the previous segment to review the problem and what the tree house detectives have learned thus far.

   Download a copy of the Problem Board from the NASA SCI Files™ web site in the educator area under the "Tools" section. Have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 1 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 1. Use tools located on the Web, as was previously mentioned in Segment 1.

4. Focus Questions–Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes while viewing the program to answer the questions. An icon will appear when the answer is near.
5. What's Up? Questions–Questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information learned will affect the case. These questions can be printed from the web site ahead of time for students to copy into their science journals.

View Segment 2 on the Video

For optimal educational benefit, view *The Case of the Biological Biosphere* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the "What's Up?" questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Have students work in small groups or as a class to discuss and list what new information they have learned about the quarantine, disease, bacteria, cells, tissues, organs, body systems, viruses, and how infectious disease is spread. Organize the information and determine if any of the students' questions from Segment 1 were answered.
4. Decide what additional information is needed for the tree house detectives to determine the best way for Jacob to stay healthy for his trip. Have students conduct independent research or provide students with information as needed. Visit the NASA SCI Files™ web site for an additional list of resources for both students and educators.
5. Choose activities from the educator guide and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
6. If time did not permit you to begin the web activity at the conclusion of Segment 1, refer to number 6 under "After Viewing" on (p.15) and begin the Problem-Based Learning activity on the NASA SCI Files™ web site. If the web activity was begun, monitor students as they research within their selected roles, review criteria as needed, and encourage the use of the following portions of the online, Problem-Based Learning activity:

   Research Rack–books, internet sites, and research tools

   Problem-Solving Tools–tools and strategies to help guide the problem-solving process

   Dr. D's Lab–interactive activities and simulations

   Media Zone–interviews with experts from this segment

   Expert's Corner–listing of Ask-An-Expert sites and biographies of experts featured in the broadcast

Careers

biology professor
respiratory therapist
dermatologist
cardiologist
cellular biologist

7. Have students write in their journals what they have learned from this segment and from their own experimentation and research. If needed, give students specific questions to reflect upon as suggested on the PBL Facilitator Prompting Questions instructional tool found in the educator's area of the web site.
8. Continue to assess the students' learning, as appropriate, by using their journal writings, problem logs, scientific investigation logs, and other tools that can be found on the web site. Visit the Research Rack in the tree house, the online PBL investigation main menu section "Problem-Solving Tools," and the "Tools" section of the educator's area for more assessment ideas and tools.

Resources

Books

Balkwill, Fran, Dr.: *Cell Wars (Cells and Things)*. First Avenue Editions, 1994, ISBN: 087614637X.

Cole, Joanna: *The Magic School Bus: Inside the Human Body*. Scholastic Trade, 1990, ISBN: 0590414275.

Ganeri, Anita: Inside the Body: *A Lift-The-Flap Book*. DK Publishing, 1996, ASIN: 0789409992.

Hawcock, David: *Amazing Pull-Out Pop-Up Body In A Book*. DK Publishing, 1997, ISBN: 078942052X.

Parker, Steve: Eyewitness: *Human Body (Eyewitness Books)*. DK Publishing, 1999, ISBN: 0789448831.

Sweeney, Joan: *Me and My Amazing Body*. Crown Publisher, 1999, ISBN: 0517800535.

VanCleave. Janice: *Janice VanCleave's The Human Body for Every Kid : Easy Activities that Make Learning Science Fun*. John Wiley & Sons, 1995, ISBN: 0471024082.

Walker, Richard: *Encyclopedia of the Human Body*. DK Publishing, 2002, ISBN: 0789486725.

Websites

Reference Resources: Human Body

BrainPOP: Here is a terrific educational, health resource for kids, offering animated movies that explain the human body.
http://www.kidinfo.com/Health/Human_Body.html

My Body

This great web site teaches you all about the human body and much more. Come explore the skin and why you need to wash it daily. Learn why you vomit and run a fever sometimes and much more.
http://kidshealth.org/kid/body/mybody.html

Activities and Worksheets

In the Guide

On the Web

Going Cellular

Problem

To identify the structures found in a typical animal cell by constructing a model

Teacher Prep

Prepare gelatin dessert mix according to package directions, using only half the recommended amount of water. Let the mixture cool to room temperature. For each group or each student, pour the mixture into a re-sealable bag (one-third full).

Background

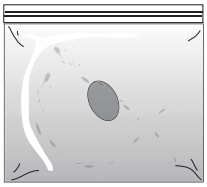
Your body contains trillions of cells. Each cell has a specific job to perform, and all cells must work together to keep you alive and healthy. All cells in your body have at least three parts: a cell membrane, a nucleus, and cytoplasm. Cells come in different shapes and sizes, but most are too small to see with the unaided eye. Cells live for different amounts of time. Bone cells can live for years, while cells in your small intestines only live a few days. Cells die in your body every second, but new cells are constantly being made to replace them.

Materials

- re-sealable plastic bag
- gelatin dessert mix
- banana slices
- seedless grapes
- lettuce leaf
- cherries
- fruit snacks
- plastic knife
- cookie sheet(s)
- tape
- food prep gloves (optional)
- spoons (optional)
- paper plates (optional)
- science journal

Procedure

1. Wash hands thoroughly with warm soapy water or use plastic food preparation gloves.
2. To prepare fruit for making a cell–
   a. Peel two or three seedless grapes (lysosomes).
   b. Slice a piece of banana (nucleus).
   c. Remove stems from four cherries (mitochondria).
   d. Cut a lettuce leaf into two 1-cm strips (Golgi bodies).
   e. Use the plastic knife to cut three 1-cm strips of fruit snack. Press the ends of the strips together to make one long strip. Fold the strip back and forth several times to make it look crinkled (endoplasmic reticulum).



3. Open the bag and insert the fruit and lettuce into the gelatin mixture.
4. Press the bag together to squeeze out any excess air and seal it closed.
5. Lay the bag flat on a cookie sheet and arrange the fruit so that it is not bunched together. This can be done without reopening the bag.
6. Create a label with your name or group's name and tape it to your bag.
7. Place the cookie sheet with the bags in the refrigerator for three to four hours until firmly set.
8. Once the cell has set, observe and draw a diagram of your cell in your science journal. Be sure to label the diagram by using the terms cytoplasm, nucleus, mitochondria, lysosomes, endoplasmic reticulum, Golgi bodies, and cell membrane. If desired, color the diagram.
9. Carefully squeeze the bag and note any change in the shape of the cell and placement of the organelles (cell parts). Record in your science journal.
10. If your teacher directs, enjoy eating your cell!

Conclusion

1. What did the gelatin represent?
2. What job does the nucleus perform for the cell?
3. What did the plastic bag represent?

Extension

1. Research the function of each organelle and describe its job within the cell.
2. Investigate a plant cell and describe how it is different from an animal cell.
3. Look at prepared slides of different types of cells. Compare and contrast nerve cells, muscle cells, and red blood cells.
4. Make your own slides of cells by taking swabs from the inside of your cheek.
5. Learn who first discovered the cell and who developed the cell theory.

Give Me Some Skin

Problem

To understand that the skin is a sensor that warns you of danger

Materials

3 paper clips
metric ruler
touch chart
red and blue marker
science journal

Background

Your skin is the largest organ of your body. An adult skin can weigh four kg and be over 1.8 square meters in area. The skin is made up of many layers. The outer layer is called the epidermis and its top has dead and dying cells that you are constantly shedding. The layer under the epidermis is called the dermis where new skin cells are made to replace the dead ones. The dermis, contains nerves, muscle, and a blood supply. It also contains glands that oil your skin and make you sweat. The bottom layer contains mainly fat that cushions your skin and attaches to your muscle. Your skin does four important jobs. It helps keep your body cool and comfortable, it is a sensor that warns you of danger, it provides protection from dirt and bacteria, and it helps eliminate your body's waste material.

Procedure

1. Unfold the three paper clips and then fold in half.
2. Use a metric ruler to measure the distance between the two ends of each paper clip. Bend the ends so that the ends of one paper clip are about 4 cm apart, the second one, 2 cm apart, and the third one, 1 cm apart.
3. Have your partner close his or her eyes. Touch your partner very lightly on the bare upper arm with both ends of the first paper clip.
4. Ask your partner if he or she can feel one or two points and record in touch chart.
5. Repeat steps 3-4 with the 2-cm and 1-cm paper clips.
6. Test the other areas listed in the chart.
7. Once you have tested all areas, switch places with your partner and repeat the tests.

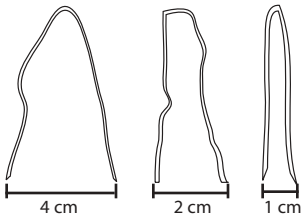


Diagram 1

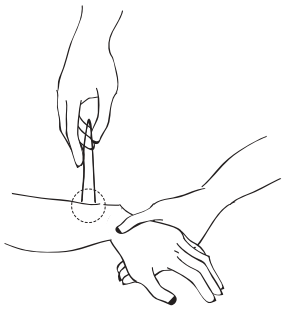


Diagram 2

Test Area	4 cm	2 cm	1 cm
Upper Arm			
Forearm			
Top of Wrist			
Back of Right Hand			
Fingertip			
Palm of Left Hand			

Conclusions

1. Which areas in your arm were most sensitive?
2. Which areas in your partner's arm were least sensitive?
3. Explain why some areas are more sensitive than others.
4. How does your skin warn you of danger?

Just Breathe

Problem

To demonstrate how the lungs work as part of the respiratory system

Materials

2-liter plastic bottle
plastic straw
clay
9-inch balloon
12-inch balloon
2 rubber bands
tape
scissors

Teacher Prep

Cut the bottom off each bottle used

Background

The respiratory system consists of the respiratory tract, which includes the nose, mouth, windpipe, and lungs. Air enters through the mouth or nose and then passes into the windpipe (trachea). The trachea divides into two bronchial tubes that lead to two separate lungs. The lungs are about the size of footballs, and they fill the chest cavity from neck to ribs. Each lung contains hundreds of millions of tiny air sacs called alveoli. Oxygen passes through the alveoli in dissolved form into the blood. The diaphragm, a dome-shaped muscle under the chest, contracts and flattens, bringing air into your lungs automatically, without your having to consciously think about it. Because the body's nervous system controls the flow of air in and out, breathing is called an involuntary control. You can voluntarily control your breathing by forcing your diaphragm to contract either more quickly or more slowly.

Procedure

1. Fasten the small balloon to one end of the straw by wrapping a rubber band around it. Be sure to fasten it tightly.
2. To make a diaphragm, cut a circular shape from the large balloon big enough to cover the bottom of the bottle so that there is approximately a 3-cm overlap.
3. Stretch the balloon over the bottom of the bottle and fasten it with a rubber band. To seal the rubber to the bottle, add a layer of tape around the edge of the balloon where it meets the bottle. See diagram 1.
4. Insert the straw with the balloon into the bottle so that the balloon is inside but not touching the bottom of the bottle.
5. Use clay to plug the opening and to secure the straw. See diagram 2.
6. Carefully observe the lung model. Predict what will happen to the balloon inside the model when you pull down on the rubber sheet. Record results in your science journal.
7. Have your partner hold the bottle while you place one hand over the straw opening. With the other hand, gently pull down and push up on the rubber sheet at the bottom of the bottle. Observe and record your observations.
8. Switch places with your partner and repeat.
9. Close your mouth, hold your nose, and try to expand your diaphragm. Record what happened in your science journal.

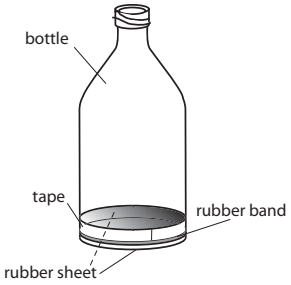


Diagram 1

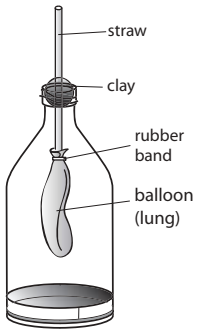


Diagram 2

Conclusion

1. Explain what happened to the balloon on the inside of the bottle (lung).
2. Compare the parts of the lung model to the respiratory system.
3. Trace the flow of air through the respiratory system.
4. Why is Jacob concerned about the respiratory system?

Extension

1. Use a stethoscope to trace the flow of air through the respiratory system. Place it on the nose, trachea, and chest while breathing in and out normally.
2. Create a simplified lung model to demonstrate what smoking can do to lungs by using a 2-liter bottle, straw, clay, cotton balls, and cigarettes. Place 5-10 white cotton balls in the bottom of the bottle. Insert straw and seal with clay as in previous experiment but without the balloon attached. Place a cigarette into the straw with the filter end down. Take the model to an open-air area and light the cigarette. Gently squeeze the bottle to simulate inhaling and exhaling. It will probably take 2-4 cigarettes to turn the cotton balls a yellowish color. Discuss what happens to your lungs when you smoke.

Tiny Creatures

Background

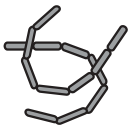
To compare and contrast three types of bacteria

Procedure

1. In your group, research three types of bacteria: coccus, bacillus, and streptococcus. You may want to assign a bacterium to each group member.
2. Record your findings in the chart below.
3. In your group, compare and contrast the three types of bacteria.
4. Design and draw a picture of your bacterium on construction paper.
5. In your science journal, write a brief description of your bacterium.
6. Present your group findings to the class.

Materials

Internet
book resources
3 pieces of construction paper
colored pencils
science journal



coccus	bacillus	streptococcus

Outbreak (Teacher Sheet)

Problem

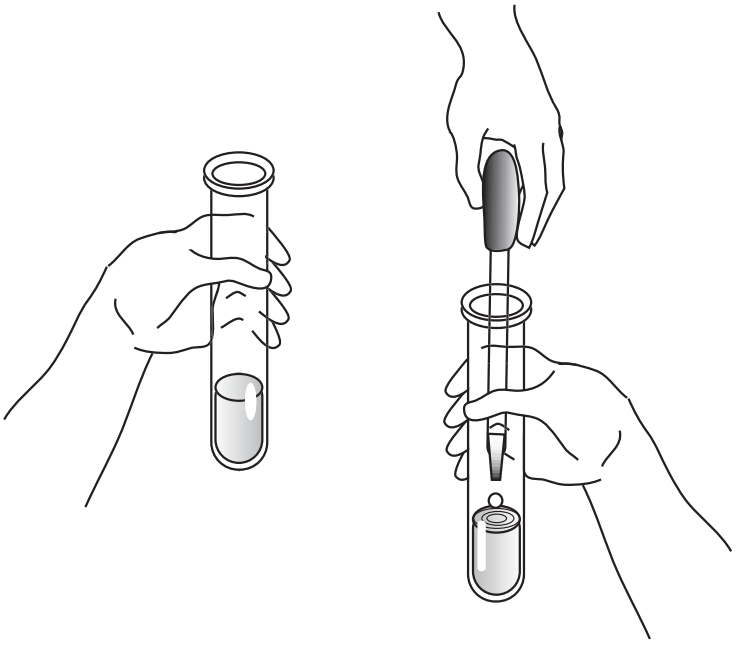
To simulate an epidemic

Materials

test tubes
eyedroppers
ammonia (non-sudsy)
cabbage juice (prepared)
distilled water
science journal

Teacher Prep

1. Cut 1-2 leaves of red cabbage into small pieces and place in a small bowl. Add water and microwave for about 2 minutes. Pour the solution into a flask or jar and set aside.
2. Use a grease pen or marker to number a test tube for each student.
3. Prepare the infected test tube by filling it 2/3 full of ammonia (non-sudsy). Remember the number of this test tube.
4. Fill the remaining test tubes 2/3 full of distilled water.
5. If necessary, demonstrate how to use an eyedropper.
6. Review safety rules.
7. Pass out the test tubes.
8. Explain to the students that one student has a cold virus (tube of ammonia) and that they will learn how viruses spread.
9. Using the eyedropper, have students exchange test tube liquids following the directions on the student data sheet. You may want to have the students choose their exchange partners before beginning the experiment to create less confusion upon exchange.
10. Once all exchanges have been completed, have the students return to their desks and carefully hold their test tubes.
11. Place 100 drops of the cabbage juice (indicator) into each test tube and have students observe any color change. This may take a few minutes. Some of the solutions will turn different colors: yellow (ammonia), green (most infected), blue (slightly infected), and purple (not infected).
12. Explain to the students what the different colors indicate.
13. Have the students try to retrace their patterns and attempt to find the initial "carrier" of the virus.



Outbreak (Student Sheet)

Student Name: _____ Test Tube #: _____

Student Data Sheet

Procedure

1. Using the eyedropper, place four drops of your liquid into another student's test tube, being careful not to touch his/her liquid with your eyedropper.
2. Have that student add four drops of his/her liquid to your test tube. Squeeze your eyedropper into your test tube to return all of the liquid to your test tube.
3. Use your eyedropper to slightly stir the liquid in your test tube.
4. Record the exchange in the chart below.
5. Repeat steps 1-4 with three different students.
6. Once the exchanges have been completed, return to your desk.
7. After your teacher adds the indicator solution to your test tube, observe the color and record.

Trial	Name of Student	Number of Drops Exchanged
1		
2		
3		
4		

Conclusion

1. When the indicator was added to your test tube, what color did the liquid become?
2. What did the change in color indicate?
3. When you eat or drink after a person, you can exchange body fluids. Describe how that exchange can result in transmitting a disease to another person.
4. Describe how this experiment could simulate the spread of an epidemic.
5. Discuss and identify ways to help control the spread of infectious disease.

Answer Key

Going Cellular

1. The gelatin represented cytoplasm.
2. The nucleus is the control center that directs all activities of the cell.
3. The plastic bag represented the cell membrane, which is a thin, film-like outer layer that holds a cell together and separates it from its environment.

Give Me Some Skin

1. Answers will vary.
2. Answers will vary.
3. Some parts of the body are more sensitive than others because receptors are not evenly spread over the body. Instead they are arranged in clusters. Areas that are most sensitive are those that have the greatest number of receptors in one place. Some of the most sensitive parts of your body are the fingertips and the end of your nose. The area least sensitive to touch is the back of the shoulder.
4. Your skin alerts your brain when it is in danger by sending signals to the brain when the skin feels pain. If you touch something hot, your skin will signal that the skin is hurting, and your brain will tell your hand to move away from the heat source that is burning you.

Just Breathe

1. When you pulled on the rubber sheet, the balloon inside the bottle had room to expand. This ability to expand caused a difference in air pressure. The pressure inside the balloon dropped and the higher air pressure from outside rushed in to equalize the pressure causing the balloon to inflate.
2. The straw opening represents the mouth and/or nose, the straw is the trachea, the balloon is the lung, and the rubber sheet is the diaphragm.
3. When we inhale, air enters through the mouth and/or nose and goes into the trachea and then into the lungs. When we exhale, air leaves the lungs and goes through the trachea and back out the mouth and/or nose.
4. The respiratory system is of particular concern to Jacob because most infectious diseases affect either the respiratory system or the digestive system. After taking the petri dishes, Mr. Frank, Jacob learned that there are a lot more airborne microbes in the tree house than in his own home. These microbes could be infectious, and if he breathes them in, he might get sick.

Outbreak

1. Answers will vary but should be yellow, green, blue, or purple.
2. The change in color indicated the amount of infection that the person received.
3. Eating or drinking after another person causes you to intake a small amount of their body fluids. If they are infected with a disease or illness, you expose your body to those germs. You can then possibly become ill.
4. This experiment shows how quickly an infectious disease can spread without people even knowing it until it is too late. We come in contact with numerous people throughout the day, and if we are infected we can possibly infect them too.
5. You can control the spread of infectious disease by not eating or drinking after other people. You should also wash your hands frequently and not put your hands in your mouth or near your nose and eyes. Germs can enter these areas more easily than other areas. Covering your mouth when you cough or sneeze can also prevent the spread of infection.

On the Web

Cool Breezes

1. The alcohol felt cooler because it evaporated faster than water. The quick evaporation helps the body heat to radiate away from the skin more quickly, thereby cooling it faster.
2. On very hot humid days the air is already full of water vapor and it is unwilling to accept more. The perspiration on your skin tends to stay on your skin rather than evaporating into the air. If the humidity is at 80 percent, that means that the air contains 80 percent of the water it can hold. At this humidity, your cooling system is slower and operates at only about 20 percent efficiency. Therefore, you feel sweaty and sticky.
3. Bathing in alcohol used to be an acceptable means of bringing a fever down. However it is no longer recommended because alcohol can be absorbed through the skin and cause alcohol poisoning, which can be deadly.
4. You could make your skin feel cooler by fanning yourself or standing in a cool breeze. The moving air helps to evaporate the water more quickly.